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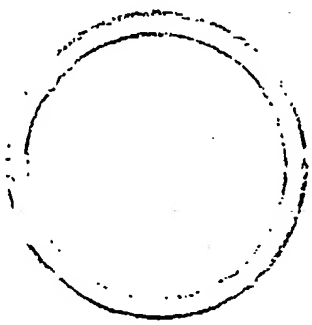
(54) Title: GOLF BALL

(57) Abstract: The present invention is a golf ball (10) having a core (12) and a cover (14). The core (12) has a diameter of 1.50 inches to 1.56 inches, and a PGA compression of 55 to 70 points. The cover (14) has a thickness of 0.60 inch to 0.90 inch. The cover (14) has a Shore D hardness less than 64 as measured on the land surface of the golf ball (10). The golf ball (10) has a ball velocity off a driver at a medium speed that is greater than 132.7 fps.



WO 02/058799 A1

TITLE

GOLF BALL

Techical Field

The present invention relates to a golf ball. More specifically, the present invention relates to a two-piece golf ball with a cover layer composed of an ionomer blend and a core containing polybutadiene, tungsten, and other materials.

Background Art

Two-piece golf balls with ionomer covers have been in existence since the 1960's. The core is typically solid, and the cover is usually a hard ionomer material. The two-piece golf balls of the prior art provide added distance while giving up feel.

Disclosure of the Invention

One aspect of the present invention is a golf ball having a core and a cover. The core has a diameter of 1.50 inches to 1.56 inches. The core is composed of polybutadiene, zinc oxide in an amount of 7 to 15 parts per hundred parts of polybutadiene, zinc diacryalate in an amount of 30 to 50 parts per hundred parts of polybutadiene, an initiator in an amount of 0.1 to 1.0 parts per hundred parts of polybutadiene, and tungsten in an amount of 5 to 10 parts per hundred parts of polybutadiene. The core has a PGA compression of 55 to 70 points. The cover has a thickness of 0.60 inch to 0.90 inch. The cover is composed of an ionomer blend formed from a high acid ionomer resin neutralized with zinc, a high acid ionomer resin

neutralized with sodium, and a terpolymer neutralized with magnesium. The cover has a flexural modulus ranging from 50,000 psi to 65,000 psi, and a Shore D hardness ranging from 60 to 65. The golf ball has a PGA compression ranging from 80 to 90 points.

Another aspect of the present invention is a golf ball having a core and a cover. The core has a diameter of 1.50 inches to 1.56 inches, and a PGA compression of 55 to 70 points. The

cover has a thickness of 0.60 inch to 0.90 inch. The cover has a Shore D hardness less than 64 as measured on the land surface of the golf ball. The golf ball has a ball velocity off a driver at a medium speed that is greater than 132.7 fps.

Yet another aspect of the present invention is a golf ball having a core and a cover. The core has a diameter of 1.50 inches to 1.56 inches, and a PGA compression of 55 to 70 points. The cover has a thickness of 0.60 inch to 0.90 inch. The cover has a Shore D hardness less than 64 as measured on the land surface of the golf ball. The golf ball has a ball velocity off a five iron at a medium speed that is greater than 115.0 fps.

Yet another aspect of the present invention is a golf ball having a core and a cover. The core has a diameter of 1.50 inches to 1.56 inches, and a PGA compression of 55 to 70 points. The cover has a thickness of 0.60 inch to 0.90 inch. The cover has a Shore D hardness less than 64 as measured on the land surface of the golf ball. The golf ball has a COR that is greater than 0.795 points.

Brief Description of the Drawings

FIG. 1 is an equatorial view of a preferred embodiment of a golf ball of the present invention.

FIG. 2 is a cross-sectional view of a golf ball of the present invention.

FIG. 3 is a graph of the cover Shore D hardness (x-axis) versus the Ball Velocity using a driver at a medium swing speed (y-axis) for the golf ball of the present invention and 12 competitor golf balls.

FIG. 4 is a graph of the cover Shore D hardness (x-axis) versus the Ball Velocity using a five-iron at a medium swing speed (y-axis) for the golf ball of the present invention and 12 competitor golf balls.

FIG. 5 is a graph of the cover Shore D hardness (x-axis) versus the Coefficient of Restitution (COR) for a golf ball (y-axis) for the golf ball of the present invention and 12 competitor golf balls.

Best Mode(s) For Carrying Out The Invention

As shown in FIGS.1 and 2, the golf ball of the present invention is generally designated 10. The golf ball 10 has a core 12 and a cover 14 encompassing the core. The surface of the cover 14 has an aerodynamic pattern thereon composed of a plurality of dimples. A preferred aerodynamic pattern is disclosed in co-pending U.S. Patent Application Number 09/768,847 filed on an even date herewith, entitled Aerodynamic Pattern For A Two-Piece Golf Ball, corporate docket number PU1178, which pertinent parts are hereby

incorporated by reference.

The golf ball 10 of the present invention is directed at a two-piece golf ball that has a relatively medium hardness cover 14 encompassing a core 12 with a relatively medium core compression. The construction of the golf ball 10 allows for a golf ball 10 that has a softer hardness while providing greater velocity than other competitive golf balls.

The core 12 of the golf ball 10 is the "engine" for the golf ball 10 such that the inherent properties of the core 12 will strongly determine the initial velocity and distance of the golf ball 10. A higher initial velocity will usually result in a greater overall distance for a golf ball. In this regard, the Rules of Golf, approved by the United States Golf Association ("USGA") and The Royal and Ancient Golf Club of Saint Andrews, limits the initial velocity of a golf ball to 250 feet (76.2m) per second (a two percent maximum tolerance allows for an initial velocity of 255 per second) and the overall distance to 280 yards (256m) plus a six percent tolerance for a total distance of 296.8 yards (the six percent tolerance may be lowered to four percent). A complete description of the Rules of Golf are available on the USGA web page at www.usga.org. Thus, the initial velocity and overall distance of a golf ball must not exceed these limits in order to conform to the Rules of Golf. Therefore, the core 12 for a USGA approved golf ball is constructed to enable the golf ball 10 to meet, yet not exceed, these limits.

The coefficient of restitution ("COR") is a measure of the resilience of a golf ball. The COR is a measure of the ratio of the relative velocity of the golf ball after direct impact with a hard surface to the relative velocity before impact with the hard surface. The COR may vary

from 0 to 1, with 1 equivalent to a completely elastic collision and 0 equivalent to a completely inelastic collision. A golf ball having a COR value closer to 1 will generally correspond to a golf ball having a higher initial velocity and a greater overall distance. The force of a club during a swing is transferred to a golf ball. If the golf ball has a high COR (more elastic), then the initial velocity of the golf ball will be greater than if the golf ball had a low COR. In general, a higher compression core will result in a higher COR value. The COR of the core 12 of the golf ball 10 of the present invention is preferably 75 to 80 points at 143 feet per second ("fps"), most preferably ranging from 76 to 79 points at 143 fps, and is most preferably 78.13 points at 143 fps.

In the present invention, the core components are mixed and compression molded in a conventional manner known to those skilled in the art. In a preferred form, the finished core 12 has a diameter of about 1.50 inch to about 1.62 inch for a golf ball 10 having an outer diameter of 1.68 inches, and is most preferably 1.535 to 1.545, with 1.54 the preferable diameter of the core 12. The core weight is preferably maintained in the range of about 32 to about 40 g, with 34 grams to 38 grams a more preferably range and 36 grams the most preferable weight of the core 12. The core PGA compression is preferably maintained in the range of about 54 to 70, and most preferably range about 60 to 64 with 62 the most preferable core compression.

As used herein, the term "PGA compression" is defined as follows:

PGA compression value = 180 – Riehle compression value

The Riehle compression value is the amount of deformation of a golf ball in inches under a

static load of 200 pounds, multiplied by 1000. Accordingly, for a deformation of 0.095 inches under a load of 200 pounds, the Riehle compression value is 95 and the PGA compression value is 85.

The core 12 of the golf ball 10 is generally composed of a blend of a base rubber, a cross-linking agent, a free radical initiator, tungsten and one or more fillers or processing aids. A preferred base rubber is a polybutadiene having a cis-1,4 content above 90%, and more preferably 98% or above.

The use of cross-linking agents in a golf ball core is well known, and metal acrylate salts are examples of such cross-linking agents. For example, metal salt diacrylates, dimethacrylates, or mono(meth)acrylates are preferred for use in the golf ball cores of the present invention, and zinc diacrylate is a particularly preferred cross-linking agent. A commercially available suitable zinc diacrylate is SR-416 available from Sartomer Co., Inc., Exton, Pennsylvania. Other metal salt di- or mono- (meth)acrylates suitable for use in the present invention include those in which the metal is calcium or magnesium. In the manufacturing process it may be beneficial to pre-mix some cross-linking agent(s), such as, e.g., zinc diacrylate, with the polybutadiene in a master batch prior to blending with other core components. A preferred mixing process is disclosed in co-pending U.S. Patent Application Number 09/690,373 filed on October 16, 2000, entitled A Process For Manufacturing A Core For A Golf Ball, which pertinent parts are hereby incorporated by reference.

Free radical initiators are used to promote cross-linking of the base rubber and the

cross-linking agent. Suitable free radical initiators for use in the golf ball core 12 of the present invention include peroxides such as dicumyl peroxide, bis-(t-butyl peroxy) diisopropyl benzene, t-butyl perbenzoate, di-t-butyl peroxide, 2,5-dimethyl-2,5-di-5-butylperoxy-hexane, 1,1-di (t-butylperoxy) 3,3,5-trimethyl cyclohexane, and the like, all of which are readily commercially available.

Zinc oxide is also preferably included in the core formulation. Zinc oxide may primarily be used as a weight adjusting filler, and is also believed to participate in the cross-linking of the other components of the core (e.g. as a coagent). Additional processing aids such as dispersants and activators may optionally be included. In particular, zinc stearate may be added as a processing aid (e.g. as an activator).

Tungsten is added to the core mixture to provide weight to the core 12, and hence the golf ball 10, while occupying volume minimal volume. Tungsten has a density of 19.3 grams per centimeter cubed which is much greater than the density of the polybutadiene. Thus, minimal tungsten allows for the necessary weight while allowing for more polybutadiene to be used in the core 12 to provide greater velocity. A number of other specific gravity adjusting fillers, in addition to the tungsten, may be included to obtain a preferred total weight of the core 12. Examples of such fillers include clay and barium sulfate. All such processing aids and fillers are readily commercially available. The present inventors have found a particularly useful tungsten filler is WP102 Tungsten (having a 3 micron particle size) available from Atlantic Equipment Engineers (a division of Micron Metals, Inc.), Bergenfield, NJ.

Table 1 below provides the ranges of materials included in the preferred core formulations of the present invention.

Table One: Core Formulations

Component	Preferred Range	Most Preferred Range
Polybutadiene	100 parts	100 parts
Zinc diacrylate	20-35 phr	25-30 phr
Zinc oxide	0-50 phr	5-15 phr
Zinc stearate	0-15 phr	1-7 phr
Peroxide	0.2 – 2.5 phr	0.5 – 1.5 phr
Filler Tungsten	As desired 6-10 phr	As desired 6 phr

The preferred specific gravity for the core 12 is 1.165 to 1.185, and most preferably 1.174.

The cover 14 preferably is composed of a thermoplastic material (e.g. thermoplastic or thermoplastic elastomer) or a blend of thermoplastic material (e.g. metal containing, non-metal containing or both). Most preferably the cover 14 is composed of a blend of thermoplastic materials that contain organic chain molecules and metal ions. The metal ion may be, for example, sodium, zinc, magnesium, lithium, potassium, cesium, or any polar metal ion that serves as a reversible cross-linking site and results in high levels of resilience

and impact resistance. Suitable commercially available thermoplastics are ionomers based on ethylene copolymers and containing carboxylic acid groups with metal ions such as described above. The acid levels in such suitable ionomers may be neutralized to control resiliency, impact resistance and other like properties.

In addition, other fillers with ionomer carriers may be used to modify (e.g. preferably increase) the specific gravity of the thermoplastic blend to control the moment of inertia and other like properties. Exemplary commercially available thermoplastic materials suitable for use in a cover 14 of a golf ball 10 of the present invention include, for example, the following materials and/or blends of the following materials: HYTREL® and/or HYLENE® products from DuPont, Wilmington, Delaware, PEBAX® products from Elf Atochem, Philadelphia, Pennsylvania, SURLYN® products from DuPont, and/or ESCOR® or IOTEK® products from Exxon Chemical, Houston, Texas.

The Shore D hardness of the cover 14 should be about 62 or less. It is preferred that the boundary layer 14 have a hardness of between about 54-64 Shore D, more preferably from 58 to 63, and most preferably 62. One reason for preferring a cover 14 with a Shore D hardness of 62 to 58 is to improve the feel of the resultant golf ball. The Shore D Hardness is determined according to ASTM D2240. However, the comparative testing in FIGS. 3-5 tested the Shore D hardness on the land surface of an actual golf ball by using a Shore D durometer tester while the golf ball was fixed within a holder.

It is also preferred that the cover 14 is composed of a blend of SURLYN® ionomer resins. SURLYN® 8150, 9150, and 6320 are, respectively, an ionomer resin composed of a

sodium neutralized ethylene/methacrylic acid, an ionomer resin composed of a zinc neutralized ethylene/methacrylic acid, and an ionomer resin composed of a terpolymer of ethylene, methacrylic acid and n-butyl acrylate partially neutralized with magnesium, all of which are available from DuPont, Polymer Products, Wilmington, DE.

Preferably the blend of ionomers that form the cover 14 is composed of 30 to 40 weight percent of a sodium neutralized ethylene/methacrylic acid ionomer resin (SURLYN 8150), 30 to 40 weight percent composed of a zinc neutralized ethylene/methacrylic acid ionomer resin (SURLYN 9150), and 25 to 35 weight percent of an ionomer resin composed of a terpolymer of ethylene, methacrylic acid and n-butyl acrylate partially neutralized with magnesium (SURLYN 6350). A preferred embodiment is a blend of ionomers composed of 35 weight percent of a sodium neutralized ethylene/methacrylic acid ionomer resin (SURLYN 8150), 35 weight percent composed of a zinc neutralized ethylene/methacrylic acid ionomer resin (SURLYN 9150), and 30 weight percent of an ionomer resin composed of a terpolymer of ethylene, methacrylic acid and n-butyl acrylate partially neutralized with magnesium (SURLYN 6350).

Preferably, the ionomer resins are mixed and heated, then injection molded in a flowable form over the core 12 in a conventional manner that is well-known to those skilled in the pertinent art to form the cover 14. The mold has an inverse aerodynamic pattern to form the aerodynamic pattern on the cover 14. Alternatively, the cover 14 may be manufactured using half shells that are compression molded over the core 12, which is also well-known in the pertinent art.

An alternative embodiment of the cover 14 may include a predetermined amount of a baryte mixture. The baryte mixture is included as 8 or 9 parts per hundred parts of the ionomer resins. One preferred baryte mixture is composed of 80% barytes and 20% of an ionomer, and is available from Americhem, Inc., Cuyahoga Falls, Ohio, under the trade designation 38534X1.

The cover 14 preferably has a thickness of 0.60 inch to 0.90 inch, most preferably ranging from 0.65 inch to 0.80 inch, and most preferably 0.70 inch. The cover 14 preferably has a flexural modulus (using ASTM-790) of 50,000 pounds per square inch ("psi") to 65,000 psi, most preferably 60,000psi.

The golf ball 10 is finished by applying a base coat and/or top coat to the surface of the cover 14 for whiteness and protection. Also, a logo marking may be applied to the base coat or top coat. The finished golf ball 10 has a weight of 45 to 46 grams, preferably 45. 65 grams. The golf ball 10 has a PGA compression of 70 to 95 points, preferably 80 to 90 points, and most preferably 85 points. The golf ball 10 has a COR of 75 to 85 points, preferably 77 to 83 points, and most preferably 80 points at 143fps. The golf ball 10 preferably has a diameter of approximately 1.68 inches. However, those skilled in the pertinent art will recognize that the golf ball may have a diameter that is more of less than 1.68 inches without departing from the scope and spirit of the present invention.

Table Two is a comparison of the golf ball 10 of the present invention and other competitive golf balls on the market.

Table Two

Ball	Core Compression	Ball COR	Ball Rebound	Cover Hardness	Ball Compression	Medium Speed 5-iron Ball Velocity	Medium Speed Driver Ball velocity
Golf ball 10	60.91667	0.8018	77.97917	61.8	87.91667	115.3465	133.667833
Precept MC Spin	83	0.7687	76.68333	54.33333	93.625	113.626833	131.6555
Precept MC Distance	64.66667	0.787	78.01667	64.66667	91.25	114.4907	132.836167
Precept MC Lady	40.83334	0.7872	77.85	60.66667	73.70833	114.543083	132.441917
Titleist DT Distance	74.75	0.7953	79.88333	68.66667	91.08333	114.7595	133.509667
Titleist HP Distance	54.91638	0.7712	78.41667	69	82.04167	114.115833	131.884417
Titleist HP Eclipse	82.58334	0.7566	75.85	64	98	112.996455	130.472167
Staff Titanium Straight Distance	28.33333	0.8026	80.45	70.33333	88.91666	115.753091	133.690917
Staff Smart-Core Straight Distance	33.41666	0.8042	80.31667	70	90.59091	115.624091	133.69725
Nike Distance Control	71.91667	0.7868	77.73333	64.66667	100.0833	114.629333	132.866167
Taylor Made Intergel Pro Distance	84.25	0.7697	79.96667	65.33333	105.1667	113.893545	131.928833
Slazenger Raw Distance 3	81.5	0.8036	79.93333	70	104.0833	115.33075	143.276917
Strata Distance 90	47.25	0.7873	77.93333	65	99.75	114.565455	132.755333

The ball compression for each golf ball in Table Two was measured using the PGA compression test described above for several golf balls and taking the mean value. The core compression for each golf ball in Table Two was measured by removing the cover and subjecting the core of each golf ball to a PGA compression test as described above for several

golf balls and taking the mean value. The Ball COR for each golf ball in Table Two was measured by firing each golf ball at 143fps at a solid wall as described above for several golf balls and taking the mean value. The cover hardness for each golf ball in Table Two was measured on the land surface of the golf ball using a Shore D durometer as described above for several golf balls and taking the mean value. The ball rebound for each golf ball in Table Two was measured by dropping each golf ball at a predetermined height at a solid floor as measuring the rebound for several golf balls and taking the mean value. The medium speed 5-iron ball velocity for each golf ball in Table Two was determined by hitting each golf ball with a Callaway Golf® STEELHEAD™ X-14® five iron at a speed of approximately 90 miles per hour ("MPH") for several golf balls and taking the mean value. The medium speed driver ball velocity for each golf ball in Table Two was determined by hitting each golf ball with a Callaway Golf® BIG BERTHA® HAWK EYE® VFT™ ten degree driver at a speed of approximately 90 miles per hour ("MPH") for several golf balls and taking the mean value.

As shown in FIG. 3, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 64 and a ball velocity off a driver at a medium speed that is greater than 132.7 fps. More specifically, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 63 and a ball velocity off a driver at a medium speed that is greater than 133.0 fps. Most specifically, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 62 and a ball velocity off a driver at a medium speed that is greater than 133.5 fps.

As shown in FIG. 4, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 68 and a ball velocity off a five-iron at a medium speed that is greater than 115.0 fps. More specifically, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 64 and a ball velocity off a five-iron at a medium speed that is greater than 115.0 fps. Most specifically, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 62 and a ball velocity off a five iron at a medium speed that is greater than 115.5 fps.

As shown in FIG. 5, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 68 and a COR that is greater than 0.795 points. More specifically, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 64 and a COR that is greater than 0.80 points. Most specifically, the golf ball 10 of the present invention is the only golf ball that has a Shore D hardness less than 62 COR that is greater than 0.80 points.

CLAIMS

We claim as our invention:

1. A golf ball comprising:

a core having a diameter of 1.50 inches to 1.56 inches, the core comprising polybutadiene, zinc oxide in an amount of 7 to 15 parts per hundred parts of polybutadiene, zinc diacryalate in an amount of 30 to 50 parts per hundred parts of polybutadiene; an initiator in an amount of 0.1 to 1.0 parts per hundred parts of polybutadiene, and tungsten in an amount of 5 to 10 parts per hundred parts of polybutadiene, the core having a PGA compression of 55 to 70 points; and

a cover having a thickness of 0.60 inch to 0.90 inch, the cover comprising an ionomer blend formed from a high acid ionomer resin neutralized with zinc, a high acid ionomer resin neutralized with sodium, and a terpolymer neutralized with magnesium, the cover having a flexural modulus ranging from 50,000 psi to 65,000 psi, a Shore D hardness ranging from 60 to 65;

wherein the golf ball has a PGA compression ranging from 80 to 90 points.

2. A golf ball comprising:

a core having a diameter of 1.50 inches to 1.56 inches, the core having a PGA compression of 55 to 70 points; and

a cover having a thickness of 0.60 inch to 0.90 inch, the cover having a Shore D hardness less than 64 as measured on the land surface of the golf ball;

wherein the golf ball has a ball velocity off a driver at a medium speed that is greater than 132.7 fps.

3. A golf ball comprising:

a core having a diameter of 1.50 inches to 1.56 inches, the core having a PGA compression of 55 to 70 points; and

a cover having a thickness of 0.60 inch to 0.90 inch, the cover having a Shore D hardness less than 64 as measured on the land surface of the golf ball;

wherein the golf ball has a ball velocity off a five iron at a medium speed that is greater than 115.0 fps.

4. A golf ball comprising:

a core having a diameter of 1.50 inches to 1.56 inches, the core having a PGA compression of 55 to 70 points; and

a cover having a thickness of 0.60 inch to 0.90 inch, the cover having a Shore D hardness less than 64 as measured on the land surface of the golf ball;

wherein the golf ball has a COR that is greater than 0.795 points.

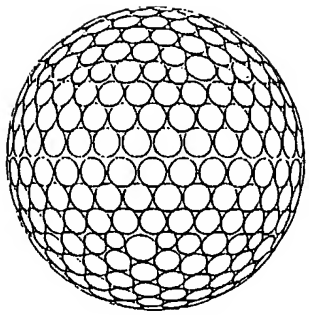


FIG. 1

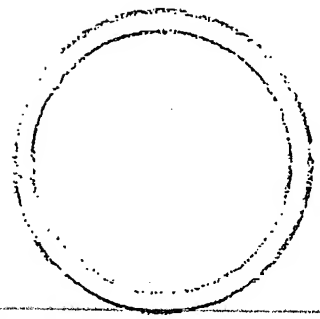


FIG. 2

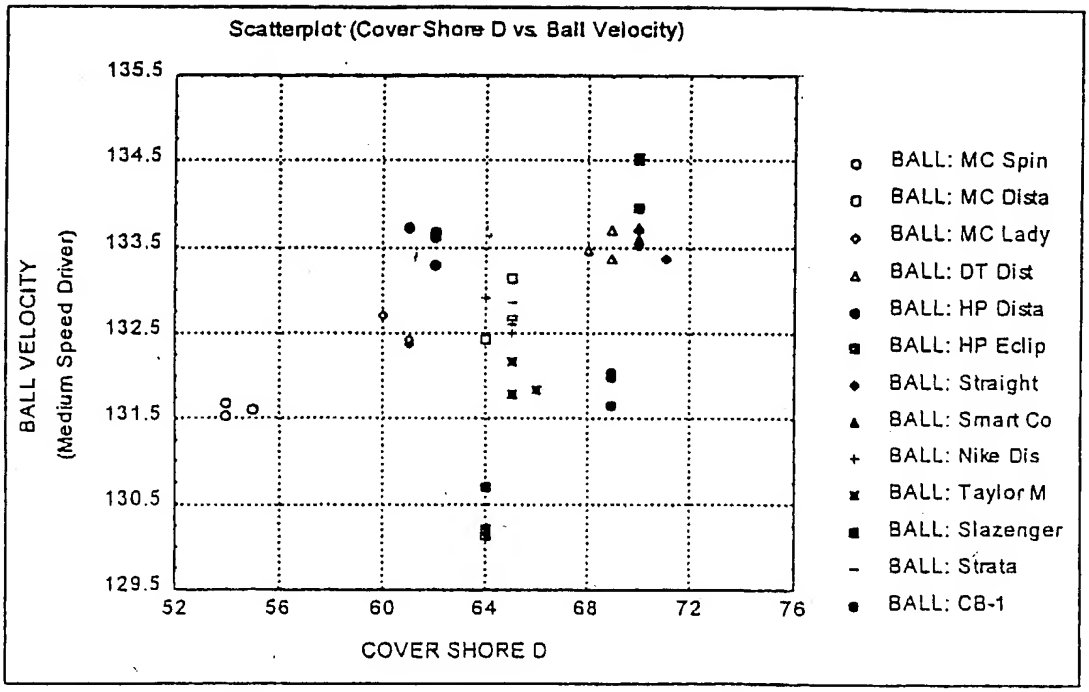
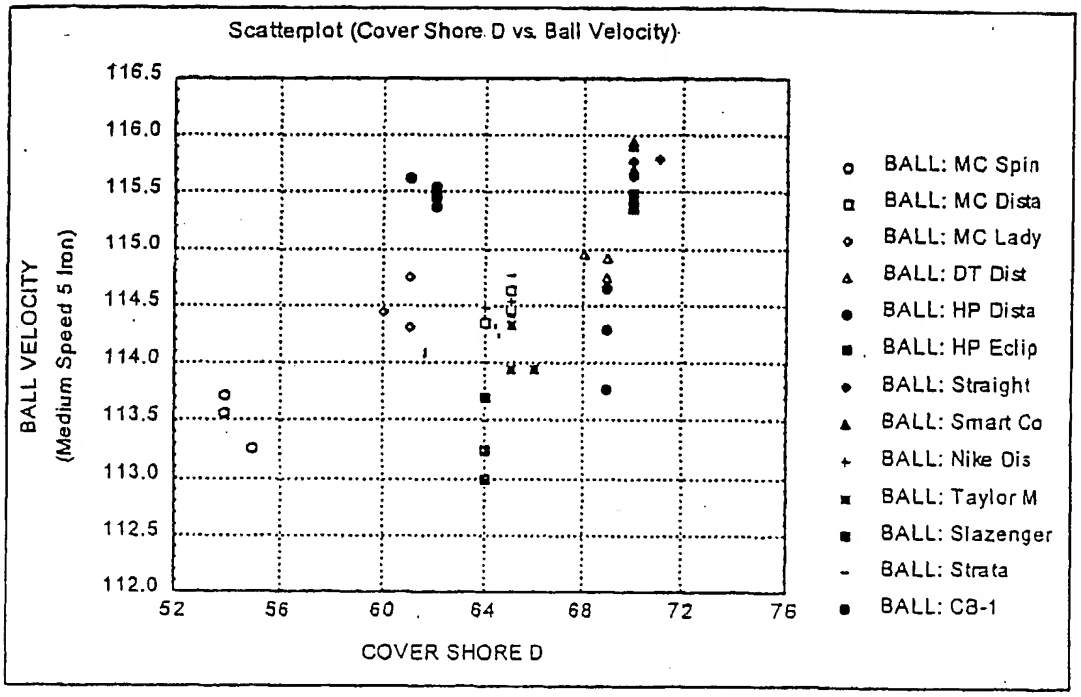

Scatterplot (Cover Shore D vs. Ball Velocity)
BALL VELOCITY
(Medium Speed Driver)
135.5
134.5
133.5
132.5
131.5
130.5
129.5
52
56
60
64
68
72
76
COVER SHORE D
BALL: MC Spin
BALL: MC Dista
BALL: MC Lady
BALL: DT Dist
BALL: HP Dista
BALL: HP Eclip
BALL: Straight
BALL: Smart Co
BALL: Nike Dis
BALL: Taylor M
BALL: Slazenger
BALL: Strata
BALL: CB-1

FIG. 3


Scatterplot (Cover Shore D vs. Ball Velocity)
BALL VELOCITY
(Medium Speed 5 Iron)
116.5
116.0
115.5
115.0
114.5
114.0
113.5
113.0
112.5
112.0
52
56
60
64
68
72
76
COVER SHORE D
BALL: MC Spin
BALL: MC Dista
BALL: MC Lady
BALL: DT Dist
BALL: HP Dista
BALL: HP Eclip
BALL: Straight
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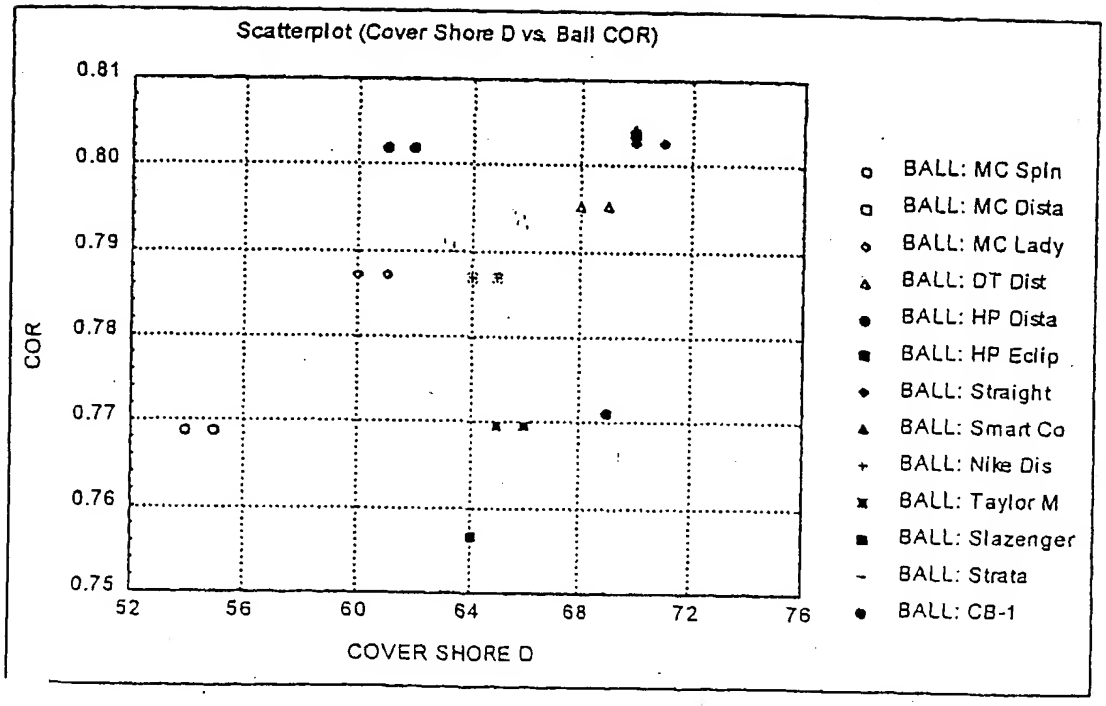
BALL: Nike Dis
BALL: Taylor M
BALL: Slazenger
BALL: Strata
BALL: C8-1

FIG. 4


Scatterplot (Cover Shore D vs. Ball COR)
0.81
0.80
0.79
0.78
0.77
0.76
0.75
COR
52
56
60
64
68
72
76
COVER SHORE D
BALL: MC Spin
BALL: MC Dista
BALL: MC Lady
BALL: DT Dist
BALL: HP Dista
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BALL: Straight
BALL: Smart Co
BALL: Nike Dis
BALL: Taylor M
BALL: Slazenger
BALL: Strata
BALL: CB-1

FIG. 5